AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application.

1.-37. (Cancelled)

38. (Previously Presented) A method for increasing or decreasing the ion conductivity of a membrane, which method comprises inserting one or more directly light-controlled ion channels into a membrane, wherein (i) the one or more directly light-controlled ion channels is a biological photoreceptor, (ii) the one or more directly light-controlled ion channels comprises an apoprotein and a light-sensitive polyene covalently bound to the apoprotein, said polyene interacting with the apoprotein and functioning as a direct light-sensitive gate, and (iii) the apoprotein includes at least amino acids 61 to 310 of the Channelopsin1 (CHOP-1) protein (SEQ ID NO: 1), thereby increasing or decreasing the ion conductivity of the membrane.

39. (New) The method of claim 38, wherein the light-sensitive polyene is a retinal or retinal derivative.

40. (New) The method of claim 39, wherein the retinal derivative is selected from the group consisting of 3,4-dehydroretinal, 13-ethylretinal, 9-dm-retinal, 3-hydroxyretinal, 4-hydroxyretinal, naphthylretinal; 3,7,11-trimethyl-dodeca-2,4,6,8,10-pentaenal; 3,7-dimethyl-deca-2,4,6,8-tetraenal; 3,7-dimethyl-octa-2,4,6-trienal; and 6-7 rotation-blocked retinals, 8-9 rotation-blocked retinals, and 10-11 rotation-blocked retinals.

41. (New) The method of claim 38, wherein proton, sodium, or calcium conductivity of a membrane is increased or decreased.

42. (New) The method of claim 38, wherein membrane potential of a cell membrane is increased or decreased.

43. (New) The method of claim 38, wherein the membrane is a cell membrane of a yeast.

44. (New) The method of claim 43, wherein the yeast is *Saccharomyces cerevisiae, Schizosaccharomyces pombe,* or *Pichia pastoris.*

45. (New) The method of claim 38, wherein the membrane is a cell membrane of a mammalian cell or an insect cell.

46. (New) The method of claim 45, wherein the mammalian cell is a COS cell, a BHK cell, a HEK293 cell, a CHO cell, a myeloma cell, an MDCK cell, or a neuron.

47. (New) The method of claim 45, wherein the insect cell is a baculovirus-infected sf9 cell.

48. (New) The method of claim 40, wherein a concentration gradient of ions across the membrane is raised or lowered.

49. (New) The method of claim 48, wherein a concentration gradient of protons, sodium, or calcium across the membrane is raised or lowered.

50. (New) The method of claim 40, wherein a light-induced membrane depolarization is realized by lowering the ion conductivity of the membrane by activating the one or more directly light-controlled ion channels by exposure to light.